

METHOD 10 - DETERMINATION OF CARBON MONOXIDE EMISSIONS FROM STATIONARY SOURCES

Applicability and Principle

Principle. An integrated or continuous gas sample is extracted from a sampling point and analyzed for carbon monoxide (CO) content using a Luft-type nondispersive infrared analyzer (NDIR) or gas filter correlation (GFC) NDIR.

Applicability. This method is applicable for the determination of carbon monoxide emissions from stationary sources. The process will dictate whether a continuous or an integrated sample is required. If the process produces CO spikes that would exceed the span (as determined from the allowable), then an integrated procedure is required.

Interferences

Any substance having a strong absorption of infrared energy will interfere to some extent, for example water and carbon dioxide. The use of silica gel and ascarite traps will alleviate the major interference problems. The measured gas volume will be corrected if these traps are used employing Equation 10-1.

Alternatively, the use of GFC NDIR will alleviate this need.

In the sections that follow, the proposed Apparatus, Analytical Method and Sampling Procedure will be checked.

Apparatus (check one)

_____ Continuous Sample

Probe. Stainless steel or sheathed Pyrex glass, equipped with a filter to remove particulate matter.

Air-Cooled Condenser or Equivalent. To remove any excess moisture.

Recorder. A strip-chart recorder, analog computer, or digital recorder for recording measurement data. The minimum data recording requirement is one measurement value per minute.

_____ Integrated Sample

Probe. Same as above.

Air-Cooled Condenser or Equivalent. Same as above.

Valve. Needle valve, or equivalent, to adjust flow rate.

Pump. Leak-free diaphragm type, or equivalent, to transport gas.

Rate Meter. Rotameter, or equivalent, to measure a flow range from 0 to 1.0 liter per minute (0 to 0.035 cfm).

Flexible Bag. Tedlar, or equivalent, with a capacity of 60 to 90 liters (2 to 3 ft³).

Leak-test the bag in the laboratory before using by evacuating bag with a pump followed by a dry gas meter. When evacuation is complete, there should be no flow through the meter.

Pitot Tube. Type S, or equivalent, attached to the probe so that the sampling rate can be regulated proportional to the stack gas velocity when velocity is varying with time or a sample traverse is conducted.

Analysis (check one)

_____ **NDIR Carbon Monoxide Analyzer.** Nondispersive infrared spectrometer, or equivalent. This instrument will have demonstrated, preferably by the manufacturer, to meet or exceed manufacturer's specifications and those described in this method (Addendum A).

Silica Gel and Ascarite Traps (check one)

_____ will be used as detailed in the method.

_____ will not be used **because:**

_____ **GFC Carbon Monoxide Analyzer.** Gas filter correlation NDIR analyzer. This instrument will have demonstrated, preferably by the manufacturer, to meet or exceed manufacturer's specifications and those described in this method (Addendum A).

Analytical Range

The span of the monitoring system will be selected such that it will not exceed 1.5 times the applicable source performance standard except as noted and justified in the "Proposed Deviations from this BTS Template or the Method Section" to follow. If at any time during the run the measured gas concentration exceeds the span; the run will be considered invalid.

Allowable = _____ lb/hr

MW = 28 lb/lbmole

Stack Flow = _____ dscfm

The in-stack concentration based on the emission standard and stack flow parameters is

$$\frac{(\text{lb/hr}) \times (387 \times 10^6)}{(\text{MW}) \times (\text{dscfm}) \times 60} = \text{_____ ppm.}$$
 Therefore, the analyzer span will be _____ ppm.

Calibration Gases

The calibration gases will be known concentration of CO in nitrogen (N₂) corresponding approximately to 30 percent (**low-range**), 60 percent (**mid-range**) and 90 percent (**high-range**) of span and a prepurified grade of N₂ for **zero**. The calibration gases will be certified by the manufacturer to be within 2 percent of the specified concentration.

The following gases will be used:

Low-range _____ ppm, **Mid-range** _____ ppm and **High-range** _____ ppm.

Calibration

The instrument will have a sufficiently long warm-up period to ensure stability is obtained. The manufacturer's instructions for any specific procedures will be followed. During this time the sample conditioning apparatus, i.e., filter, condenser, drying tube, and CO₂ removal tube will be checked to ensure that each component is in good operating condition. The instrument will be zeroed and calibrated according to the following procedures using, respectively, N₂ and the calibration gases.

Analyzer Calibration Error. The analyzer calibration error check will be conducted by introducing the zero, low-range, mid-range, and high-range gases to the analyzer. During this check, no adjustments to the system will be made except those necessary to achieve the correct calibration gas flow rate at the analyzer. The analyzer responses to each calibration gas will be recorded.

Sampling System Bias Check. The sampling system bias check will be performed by introducing calibration gases at the calibration valve installed at the outlet of the sampling probe. A zero gas and either the mid-range or high-range gas, whichever most closely approximates the effluent concentrations, will be introduced and the gas concentration displayed by the analyzer recorded. During the sampling system bias check, the system will be operated at the normal sampling rate, and no adjustments to the measurement system will be made, other than those necessary to achieve proper calibration gas flow rates at the analyzer.

Zero and Calibration Drift Tests. Immediately preceding and following each run, or if adjustments are necessary for the measurement system during the run, the sampling system bias check procedure described above will be repeated. No adjustments to the measurement system will be made until after the drift checks are completed.

Sampling Procedure (check one)

_____ **Continuous Sampling.** The equipment will be set up making sure all connections are leak free. The probe will be placed in the stack at a sampling point representative of the source emission concentration, and the sampling line purged. The system will be given 5 minutes to stabilize, then the analyzer readings will be recorded as required by the test procedure. CO₂ content of the gas may be determined by using the Method 3 integrated sampling procedure, or by weighing the ascarite CO₂ removal tube and computing CO₂ concentration from the gas volume sampled and the weight gain of the tube, if applicable.

_____ **Integrated Sampling.** The flexible bag will be evacuated. The equipment will be set up with the bag disconnected. The probe will be placed in the stack, and the sampling line purged. The bag will be connected, making sure that all connections are leak free. The sampling rate will be proportional to the stack velocity. CO₂ content of the gas may be determined by using the Method 3 integrated sample procedures, or by weighing the ascarite CO₂ concentration from the gas volume sampled and the weight gain of the tube, if applicable.

Emission Measurement Test Procedure

The necessary apparatus will be assembled, the instrument will be calibrated, and other required operations will be performed as described above. Analyzer will be purged with N₂ prior to introduction of each sample. The sample stream will be directed through the instrument for the test period, recording the readings.

Immediately following the completion of the test period and hourly during the test period, the zero and upscale calibration gases will be re-introduced one at a time to the measurement system at the calibration valve assembly. No adjustments to the measurement system will be made until both the zero and calibration bias and drift checks are made. The analyzer response will be recorded. If the bias values exceed the specified limits, the test results preceding the check will be invalidated and the test will be repeated following corrections to the measurement system and full recalibration. If the drift values exceed the specified limits, the run may be accepted but the test measurement system will be fully recalibrated and the results reported using Equation 6C-1 of Method 6C.

Measurement System Performance Specifications

Zero Drift, less than or equal to ± 3 percent of the span value. **Calibration Drift**, less than or equal to ± 3 percent of span value. **Sampling System Bias**, less than or equal to ± 5 percent of span value. **Calibration Error**, less than or equal to ± 2 percent of span.

Emission Calculation

The average gas effluent concentration will be determined from the average gas concentration displayed by the gas analyzer and is adjusted for the zero and upscale sampling system bias checks, as determined in accordance with Section 7.4 of Method 6C. The average gas concentration displayed by the analyzer may be determined by integration of the area under the curve for chart recorders, or by averaging all of the effluent measurements. Alternatively, the average may be calculated from measurements recorded at equally spaced intervals over the entire duration of the run. Calculate the effluent gas concentration using Equation 6C-1 from Method 6C.

$$C_{\text{gas}} = (\bar{C} - C_o) \frac{C_{\text{m}}}{C_{\text{m}} - C_o}$$

Emissions will be presented in the following units: _____.

Proposed Deviations from this BTS Template or the Method

(Insert any proposed deviations here)